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The RHIC Polarized Ion Source

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The high-intensity polarized H^- ion beam for RHIC produced in multi-step charge –exchange process. A high brightness primary proton beam of a 6.5 keV energy (from the surface of the plasma emitter with a low transverse ion temperature ~0.2 eV) is produced by four-electrode spherical multi-aperture ion-optical system with geometrical focusing. The converging proton beam immediately converted to neutral atomic hydrogen beam in a pulsed hydrogen gas cell. The atomic hydrogen beam injected into the superconducting solenoid (3.0 T) where it is ionized in the He-gas cell. The protons produced in the He-cell decelerated to 2.5 keV by three-grid deceleration system and neutralized again by capture of polarized electrons from optically pumped Rb-vapor (Optically Pumped Polarized Ion Source –OPPIS-technique). In such a way, beam at entrance and exit of solenoid field is neutral to avoid emittance growth in charge-exchange process in high-magnetic field. The electron polarization transferred to protons by Sona-transition and then beam is ionized in the sodium-jet ionizer cell. The H^- ion beam produced in the cell (ionizer cell is isolated and -32.5 kV pulsed HV applied to the cell) is accelerated to 35.0 keV which is transported and injected for further acceleration in RFQ. The use of high-brightness primary beam and large cross-sections of charge-exchange cross-sections resulted in production of very high intensity (up to 4.0 mA) H^- ion beam of 85% polarization. This beam intensity is much higher then RHIC acceptance and extra beam intensity is scraped by collimation after the Booster to reduce beam emittance. This reduces depolarization in AGS and RHIC and increase luminosity for polarized beam collisions in RHIC. Siberian snakes used in AGS and RHIC to prevent depolarization during acceleration. The use of high-intensity and 85% polarization source beam resulted in 75% polarization at 23 GeV out of AGS and 60-65% beam polarization at 100-250 GeV beams colliding in RHIC.